Screening tests for urinary tract infection in children: a meta-analysis

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Authors' objectives
To review systematically and to summarise the existing literature regarding the performance of rapid diagnostic tests for urinary tract infection (UTI) in children.

Searching
MEDLINE was searched from 1966 to 1998 for publications in the English language. The search terms were listed. The reference lists of included studies and review articles known to the authors were also checked for additional references. The authors' own files were handsearched and experts in the field were contacted.

Study selection
Study designs of evaluations included in the review
Diagnostic accuracy studies in which both the screening test and the urine culture were performed on all participants, and the results of the screening test were not included in the definition of UTI, were eligible.

Specific interventions included in the review
Studies that used one or more of the following tests were eligible for inclusion: urine dipstick for leucocyte esterase and/or nitrite; microscopic analysis of centrifuged urine sample for white blood cells (WBC), reported as the number of WBC per high-powered field (WBC/hpf); microscopic analysis of uncentrifuged urine sample for WBC, reported as the number of WBC/mm3; Gram stain of uncentrifuged urine; or enhanced urinalysis (cell count and Gram stain on uncentrifuged urine).

Reference standard test against which the new test was compared
The reference test was quantitative or semiquantitative urine culture.

Participants included in the review
Studies of children aged 12 years or less were eligible for inclusion. Studies of adults and children were also eligible if the results for children could be separated. The people in the included studies were aged from 0 to 21 years. Methods for obtaining urine specimens included clean catch, urine bag, suprapubic aspirate and catheter. The settings included a laboratory, referral clinic, home, out-patient department, in-patient ward, paediatric clinic, and emergency and acute care clinics.

Outcomes assessed in the review
The studies had to report sufficient data to construct a 2x2 table of test performance, to give true-positive rates and false-positive rates (TPR and FPR, respectively).

How were decisions on the relevance of primary studies made?
The titles and abstracts were reviewed for possible relevance by two authors and any discrepancies were resolved by discussion and consensus. Articles deemed relevant were retrieved and reviewed.

Assessment of study quality
No formal validity assessment was undertaken. However, the authors stated that data on any possible methodologic concerns, such as nonconsecutive enrolment or blinding, were extracted. Some quality items (avoidance of verification and incorporation bias) were specified as inclusion criteria.

Data extraction
The authors do not state how the data were extracted for the review, or how many of the reviewers performed the data
Data were extracted on the participants’ age, colony count used to define UTI, setting, methods of obtaining the sample, tests performed and sample size. A 2x2 table was abstracted for each test. If a test had multiple possible thresholds, separate 2x2 tables were abstracted for each cut-off described in the study. Separate tables were also constructed if the test results for different age subgroups or with different definitions of UTI were available in a single study. The TPR and FPR were determined separately from each included study for each test and at each threshold value.

**Methods of synthesis**

**How were the studies combined?**

The TPR and FPR of each study were plotted against each other in a scatter plot and the Spearman correlation coefficient was calculated. A summary receiver operating characteristic (ROC) curve of all the studies was then created according to the methods of Moses et al. (see Other Publications of Related Interest). Positive and negative likelihood ratios (LRs) were derived from the summary TPRs and FPRs.

**How were differences between studies investigated?**

For each diagnostic test of interest, the TPRs and FPRs were compared using a chi-squared test. Heterogeneity was indicated by a p-value of less than 0.05. Heterogeneity was then explored by examining the following subgroups: more and less stringent definitions of UTI, all ages of children and only children aged less than two years.

**Results of the review**

Twenty-six studies (n=17,096) were included.

Most of the tests showed significant heterogeneity among studies in both TPR and FPR, which was only partly explained by the stringency of the UTI definition and age of children in the studies. Based on pooled estimates derived from summary ROC curves, the test with the best combination of sensitivity and specificity was the Gram stain on uncentrifuged urine (positive LR 18.5, negative LR 0.07, sensitivity 0.93, FPR 0.05). Urine dipstick tests performed nearly as well; the presence of both leucocyte esterase and nitrites had a positive LR of 12.6 (sensitivity 0.88), while the absence of both leucocyte esterase and nitrite had a negative LR of 0.13 (FPR 0.04). Pyuria had lower TPR and higher FPR: for the presence of greater than 5 WBC/hpf in centrifuged urine, the TPR was 0.67 and the FPR was 0.21; for the presence of greater than 10 WBC/mm3 in uncentrifuged urine, the TPR and FPR were 0.77 and 0.11, respectively.

**Authors’ conclusions**

Both Gram stain and dipstick analysis for nitrite and LE perform similarly in detecting UTI in children, and are superior to microscopic analysis for pyuria.

**CRD commentary**

The inclusion criteria were explicit and details of the included studies were presented. The database search was restricted to MEDLINE, which may have led to some relevant studies being missed. The validity of the included studies was not formally assessed, although some aspects of methodology were stated to have been extracted from the included studies and used as inclusion criteria; these were not reported in the text. The pooling seems appropriate up to a point, but as the heterogeneity was not explained by the a priori subgroup analyses, it may not have been appropriate to then pool the data. The authors’ conclusions follow from the results presented, but should be treated with great caution given the above caveats.

**Implications of the review for practice and research**

**Practice:** The authors state that the TPRs and FPRs for the presence of greater than 5 WBC/hpf in a centrifuged urine specimen are so poor that it cannot be recommended for making a presumptive diagnosis of UTI.

**Research:** The authors did not state any implications for further research.
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Other publications of related interest

This additional published commentary may also be of interest. Wright S. Review: both Gram stain and urine dipstick analysis were accurate in diagnosing urinary tract infection in children. Evid Based Nurs 2000;3:86.

Indexing Status
Subject indexing assigned by NLM

MeSH
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Record Status
This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.